MECHELECIV

THE STUDENTS MAGAZINE • VOL. 28 • OCTOBER 1969 • NO. 1

THE GEORGE WASHINGTON UNIVERSITY

SCHOOL OF ENGINEERING AND APPLIED SCIENCE

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Page

COVER

Astronaut Edwin E. Aldrin on the surface of the Moon. Aldrin's faceplate reflects Astronaut Neil A. Armstrong and the Lunar Module. Photo courtesy of NASA.

FRONTISPIECE

Two views of the new classroom building built adjacent to Tompkins Hall. The new classroom building takes up space promised to the Engineering School. No engineering classes will be held in the new building.

Member
Engineering College Magazine Association
Chairman: Gordon G. Smith
Oklahoma State University

National Critic:
Jack Campbell, Prof. of English
Oklahoma State University

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There may be a satellite in your future....

Your degree in electronics, astronautics or physics; in business, personnel or marketing; or in international affairs may have prepared you for an interesting and challenging future in the exciting new world of commercial satellite communications.

Already satellites over the Atlantic and Pacific link countries on five continents and this will become worldwide with the launching of an Indian Ocean satellite.

Live television across the oceans via satellite has added a new dimension to international understanding. People now have front row seats to history as it is being made, and they can also communicate directly with each other via telephone, telegraph, data and facsimile. This can help close the gap of misunderstanding between nations and people, and opens up new opportunities for college graduates with degrees in many different fields.

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Negativism is a bad policy, admittedly, but let's face it: the George Washington University is not a Harvard, a Stanford, or a Columbia; neither is the School of Engineering and Applied Science an M.I.T., a Cal Tech, or a Berkeley. But, from personal experience, I would say that attending one of the afore-mentioned schools does not constitute instant success: i.e. an XKE, the Nobel Prize, and a penthouse in Watergate East.

The George Washington University School of Engineering and Applied Science has really got something! It would seem from past response, however, that only our administration and faculty are aware of this fact. We have approximately one hundred experts in such divergent fields as Medical Engineering, Computer Science, Systems and Operations Research, Antennae Theory, Solid State Physics, Engineering Administration, Fracture & Fatigue, and Automatic Control Systems, to list only a few. Most of these people, although probably interested in some personal research, are sincerely dedicated to instilling in us, the student body, at least an appreciation, if not a complete understanding of their field.

The administration of our Engineering School not only provides us with such an excellent faculty, they have put at our disposal an electron scanning microscope, a complete machine shop, a new EAI 580 Analog/Hybrid computer, an SDS 910 digital computer, our own keypunch facilities, and, with the reluctant blessings of the University, the IBM 360/Model 50 Digital computer. Although our labs are not teeming with *brand new* equipment, they are equipped above the interest level that the majority of us have shown.

Perhaps the greatest thing about the G.W.U. S.E.A.S. is its size. One often hears complaints among students of large schools that the professors "live in ivory towers", are under pressure to write books once a year to maintain or attain tenure, and that the professors that were brought in to give the school a "good name" are accessible only during lectures, and only from a distance then. This problem is non-existent at a small, exclusive school such as G.W.U. S.E.A.S. The student faculty rapport can best be observed at our daily coffee hour and often after hours at the spa. Many of the professors went to school here and know exactly what we're going through, and they offer valid suggestions about how to get things done.

After all this, why isn't the S.E.A.S. on the "Map"? Why *aren't* we an M.I.T.? Besides the difference in sheer size, one of the reasons may be the difference in the calibre of the undergraduate student body. Although our school has many students whom I feel are calibre enough for any of the schools mentioned before, there are many who are not up to the potential engineering education that our school is prepared to offer them.

The S.E.A.S. administration should stop changing the school to meet the potential of the students, and start matching the students they admit to the school's present and future potential. Surely, with the new dynamic leadership in admissions & recruitment, we can look for an increase in both the number and quality of the S.E.A.S. students in the coming semesters.

Wouldn't it be grand if instead of admitting thirty-five Freshmen of which ten return the second year, we could admit seventy-five Freshmen of which sixty-five return the second year. Only then will the S.E.A.S. start producing graduate engineers who, in their professions, reflect the quality of the engineering education they received from the S.E.A.S.

LETTER TO THE EDITOR

Dear Sirs:

Many years ago in a far off place there existed a small happy kingdom. It came to pass that the king became old and senile. All the subjects got together and found a new king. This new king was young and ambitious and wanted his kingdom to be known throughout the world. The new king found that his treasury was not as big as the other kingdoms of the world. The new king also had dreams of getting new subjects for his kingdom. The king then proceeded to start an all-out campaign to lure subjects to his kingdom. He hired a new duke to head up this project and gave him all the new powers he needed. To build up his depleted treasury, the king rented out his senior subjects to other kingdoms to do work for them. This made the treasury overflow. The king then hired another baron to help him with his kingdom. The king brought in many well known senior subjects from other lands to try to make his country known.

After some time, the king saw that his rate of popularity was decreasing from the year before. His new duke had done nothing except to read the records of the land. The king, realizing this, made the duke a prince and found another duke to head the problem of getting new subjects. About this same time, some of the senior subjects left the kingdom for reasons unknown. Among these was the leader of the farmers. All the farmers got together and elected a temporary leader until the king could find a new farm leader that would be worthy of his new kingdom. The king got very upset because he did not think that the new farm leader was worthy of his new kingdom. Using his regal power, the king made himself the new farm leader.

This move by the king caused much inter-turmoil within the tiny kingdom. The farmers became very reluctant to cooperate with the king. Since the farmers had no bones to pick with the kingdom's subjects they kept on providing them with food, but kept on avoiding the king. The king, meanwhile, still tried to make his kingdom the best. He hired more dukes and barons to help run the kingdom. More and more of the farmers became fed up with the king's policies. They went to more happy kingdoms to do their farming.

In the end, the kingdom was not happy ever after. It seems that the kingdom had only two subjects with the rest of the people being princes, dukes, barons, and the now unwise old king.

Signed

A Subject

Campus News

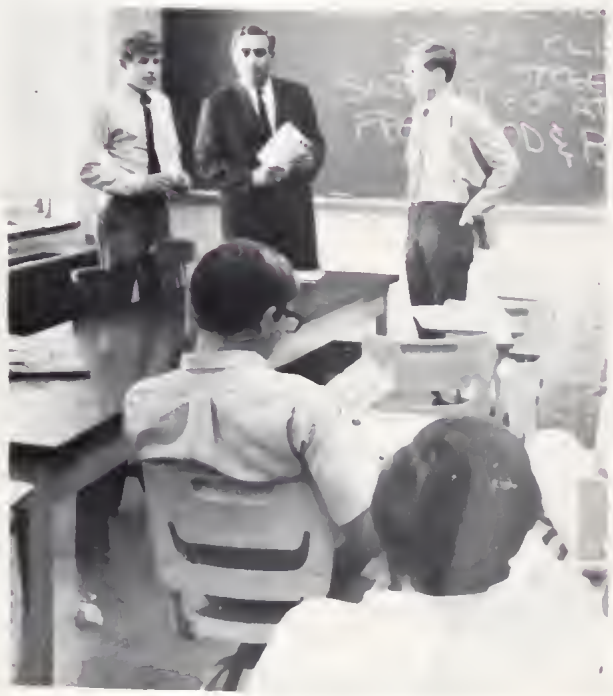
FRESHMEN ORIENTATION A BIG SUCCESS

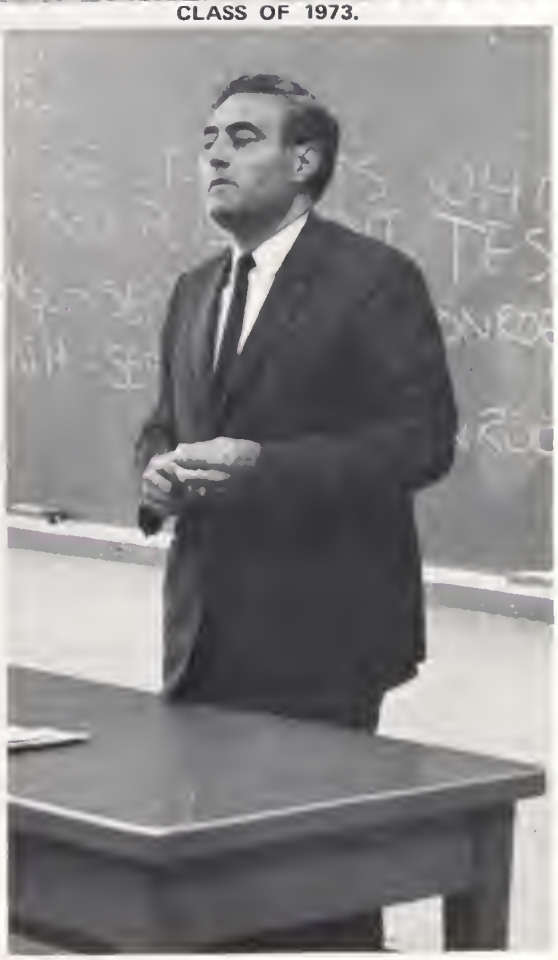
As usual, the Engineers' Council sponsored Freshmen Orientation this Fall. This year Greg Smith was Director of Freshmen Orientation. Much emphasis was placed on making the Freshman feel he is really part of the S.E.A.S. Emphasis was also placed on making the Freshman see the contributions to his overall education that he will gain by joining the various organizations the S.E.A.S. has to offer.

The Freshmen, thirty-seven in number, were acquainted with the S.E.A.S. Faculty at a special Faculty-Student Mixer at which Dean Liebowitz spoke to the Freshmen on the varied makeup of our school's curriculum, faculty, and facilities.

The Freshmen, as well as all other S.E.A.S. students, faculty, and staff, were invited to a free luncheon at the G.W. Campus Club. Everybody had as much food as they could eat and as much beer or coke as they could drink. Needless to say, the luncheon was a huge success.

CLASS OF 1973.





E.E. LAB RECEIVES A FACE LIFTING

This past summer the Electrical Engineering Department decided it was time to remodel the Electrical Engineering Lab in Room 400. As can be seen in the photograph, the number of lab bench stations has been increased, as well as the number of shelves at each station. This was done to provide a greater variety of equipment than had been at each station previously. Most of the additional equipment had been hidden away next door. Since most students never knew it existed, the equipment was seldom, if ever, used. The remodeling procedure has given the E.E. Lab an added amount of flexibility. Dr. A.C. Meltzer was of prime responsibility in achieving the remodeling. To the far right in the photo is one of our new faculty members, Dr. A. Abd-Alla, who will be teaching E.E. 163 this semester.

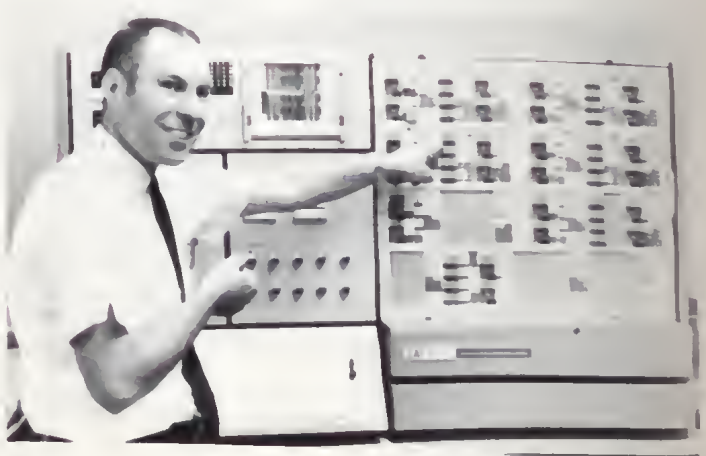
NEW COMPUTER

This past summer, the Engineering School here at George Washington obtained a new analog/hybrid computer: an Electronic Associates', Inc. Model 580. The EAI 580 is a completely new solid state ten volt, desk-top computer with a capacity of 80 computing amplifiers and eight comparator amplifiers. It is an advanced analog computer that is easy to understand and operate, in addition to providing all the capabilities needed for integration into a hybrid computing system.

The 580 was born out of the growing need for high performance analog computation, as well as the requirement for a hybrid oriented desk-top computer. It combines the low cost of a desk-top computer with the outstanding characteristics and sophistication of more costly medium and large scale analog/hybrid computers. It also offers the features a digital computer user needs so that he may take advantage of the additional capability afforded by both hybrid and modern analog computation.

The following features of the EAI 580 reflect the advanced analog and hybrid computing capabilities of the system.

- Mode selection, time selection and computing component control are accomplished by logic signals. All interator trays in the computer can be controlled individually, or in groups from the analog mode control, digital logic program or by a digital computer. This important feature permits the efficient use of iterative analog and hybrid techniques for the solution of boundary value problems and partial differential equations.
- Electronic Mode Control allows higher problem solution speeds, and more flexible control of integrators from logic devices by incorporating solid-state switches in place of relays.
- Outstanding dynamic and static characteristics of the analog computing elements permit high speed repetitive and iterative, as well as real time operation, with maximum accuracy.
- The self-contained logic expansion of general purpose logic gates, flip-flop registers, counters and digitally controlled analog switches allow decision making, event initiation, data reduction, timing and control to be accomplished directly in the EAI 580. When operating with a digital computer the logic can be either synchronized with an internal clock system or slaved to an external signal from the digital computer.
- The EAI 580 is the first desk-top analog computer with servo set potentiometers. Up to 70 servo pots can be read and set up using either the keyboard addressing system of the analog console or the digital computer. In pure analog problems they allow faster potentiometer setup. In hybrid problems these automatically adjustable potentiometers may be set to coefficients calculated by the digital computer. They may also be used directly to vary parameters during a simulation by means of a manual proportional controller.
- The computing capability of the 580 can be conveniently expanded in the field without additional console wiring. The computer console is completely pre-wired to



accept a variety of plug-in components. Power supplies provided with the basic computer are capable of operating a fully expanded console. In addition, extensive trunking and slaving facilities permit the combined operation of several 580's as one large system.

• The EAI 580 simplifies and insures full integration into a hybrid computing system by providing for direct addition of a built-in hybrid control interface.

Simplicity of operation with the superior performance and sophistication will allow graduate as well as undergraduate seniors to analyze the myriad of increasingly complex problems occurring in virtually every scientific discipline.

S.E.A.S. ANNOUNCES NEW FACULTY MEMBERS

Dean Liebowitz has announced that during the summer many new faces were added to the S.E.A.S. Faculty. The new faculty members are:

Dr. A. Abd-Alla – Assistant Professor with the E.E. Department. Dr. Abd-Alla received his PhD from the University of Maryland.

Dr. J.S. Huang – Assistant Professor with the E.E. Department. Dr. Huang received his PhD from the State University of New York.

Dr. W. Kahn – Professor with the E.E. Department. Dr. Kahn received his PhD from the Polytechnic Institute of Brooklyn.

Dr. W.H. Marlow – Professor with the Engineering Administration Department. Dr. Marlow received his PhD from the University of Iowa.

Dr. W. Mason – Research Professor with the Engineering Mechanics Department. Dr. Mason received his PhD from Columbia University.

Dr. E.N. Pugh – Associate Professor with the E.M. Department. Dr. Pugh received his PhD from the University of Wales.

Dr. N. Singpurwalla – Associate Professor with the E. Ad. Department. Dr. Singpurwalla received his PhD from New York University.

Dr. W.A. Wood – Research Professor with the E.M. Department. Dr. Wood received his PhD from Manchester University.

Editor's Note: In later issues of *Mechelecіv* magazine, an in-depth interview with the new faculty members will be presented in a revised department – "Faculty Spotlight".

DR. MELTZER IS IN THE NEWS –

Dr. Arnold C. Meltzer, Associate Professor of Engineering and Applied Science was recently appointed Acting Chairman of the Department of Electrical Engineering by Dean Harold Liebowitz. With this appointment, Dr. Meltzer replaces Dean Liebowitz who appointed himself Acting Chairman of the E.E. Department after the sudden resignation of this post by Dr. Louis de Pian early last Spring. An Ad Hoc Committee for Recommendation of Chairman has been formed in the E.E. Department. Dr. Meltzer will serve until a permanent chairman is appointed.

Dr. A.C. Meltzer has also received a grant of $51,000.00 from NASA-Langley for Analysis and Design of Distributed RC Active Filters. Dr. Meltzer, who is the principal investigator, will have two graduate students working with him on this project. The research is concerned with the utilization of digital computer programs to analyze and design these special purpose filters. The research will be conducted at the E.E. Laboratories in Tompkins Hall.

OTHER FACULTY NEWS NOTES –

Dr. Galip N. Arkilic, Professor of Applied Science has been appointed Acting Assistant Dean to the School of Engineering and Applied Science by Dean Harold Liebowitz. Dean Liebowitz stated that Dr. Arkilic will serve in this position until the S.E.A.S. faculty can select a permanent Assistant Dean.

Dr. Alfred Freudenthal, Professor of Civil Engineering and Director of the Institute for the Study of Fatigue and Reliability, has assumed the position of chairman of the Engineering Mechanics Department while Dr. Arkilic is Acting Assistant Dean. The next issue of *Mechelecіv* will have a special feature on Dr. Freudenthal's Institute.

Dr. Nelson T. Grisamore, part-time Executive Secretary of the Advisory Committee on Data Processing Systems for Anti-Ballistic Missile Defense, Division of Engineering, has left his post as a faculty member at the George Washington University to assume the full-time responsibilities as Executive Secretary. Dr. Grisamore received his doctorate in Physics at G.W.U. in 1954.

SUMMER INSTITUTE FOR BIOMEDICAL RESEARCH

Researchers at NASA's Goddard Space Flight Center this summer have developed two medical instrument prototypes that will enable doctors to care for their patients economically and effectively. The first of these prototypes was an activity meter to monitor a patient for up to a twenty-four hour period. The second was an ultrasonic unit that will allow doctors to observe blood flowing through the body.

Among these researchers were seven undergraduates from G.W.'s Engineering School. In fact, all ten of the researchers were undergraduate engineering students. These

Continued on Page 23

ORGANIZATIONS NEWS

A.S.C.E.

The American Society of Civil Engineers Student Chapter is the first step from formal curricular training to the attainment of professional status in the civil engineering profession. This professional growth results from a well balanced combination of technical and professional achievements. The classroom offers technical advancements and the A.S.C.E. Student Chapter offers the much needed professional advancement.

We are fortunate to have an A.S.C.E. Student Chapter here at G.W. All students interested in civil engineering are eligible for membership, and all students in the Civil Engineering Curriculum are urged to join. Our activities include outside speakers on technical and professional subjects, field trips to points of engineering interest, student chapter conferences, and others.

Meetings are held at least once each month, depending on exam and work schedules of our members. Notices of meetings are posted throughout the engineering school well in advance of the meeting date. Come to our organizational meeting and get acquainted with our members and new students.

Join now and participate. You cannot afford not to.

November 5 – Movie: "Die Casting" – explains die casting, uses of different metals, and other metal-working methods. (35 Min.)

November 12 – Movie: "To Be Forged" – a complete up-to-date picture of the forging industry. (18 Min.)

ASME

Welcome from the American Society of Mechanical Engineers! During the coming year, A.S.M.E. hopes to bring out a greater awareness of the engineering profession.

For instance, last year we heard from Mr. Pfanstiehl, Director of Community Services on the proposed Metro Subway System. Also, we sponsored a field trip to the Bethlehem Steel Company at Sparrows Point, Maryland. Some ways that A.S.M.E. tries to promote student fellowship is through studies assistance and luncheons.

A.S.M.E. not only wants to provide you with direction in the Mechanical Engineering profession but also needs your membership and leadership in A.S.M.E. and the Engineers' Council.

Kenneth Hum

THE ENGINEERS' COUNCIL

The Engineers' Council is the student government of the School of Engineering and Applied Science. It provides a formal and effective means of communication between the students and the faculty and administration. The Council also sponsors general social, educational, and professional functions and coordinates the activities of its member organizations. By offering a well rounded program, the Council hopes that both graduate and undergraduate students will take an interest in the school and participate in as many activities as possible.

Functions which appeal to a particular segment of the Engineering student body are generally sponsored by the member organizations of the Council. These organizations include: the Institute of Electrical and Electronics Engineers, the American Society of Civil Engineers, the American Society of Mechanical Engineers, Theta Tau, Sigma Tau, and Tau Beta Phi. Each of these organizations has one representative to the Council. There are also two representatives from each class on the Council. Sophomore, Junior, and Senior elections take place in the Spring, while the Freshmen elect their representatives early in the Fall. An Engineering student elected to the University Student Assembly during the second semester also holds a seat on the Engineers' Council. Two graduate representatives, the D-H House Manager and the Engineers' Week Chairman, are appointed by the President.

The Council's budget is derived mainly from the Engineer's fee of a dollar fifty ($1.50) charged to each student during Fall and Spring registration. This fee is used to cover in part or in full school interests such as the *Mechelecіv* Magazine, Engineers' Week, the Engineers' Ball and so on.

Engineering School activities are posted on the bulletin boards in both stairways of Tompkins Hall. The locations and times of Council meetings are also posted. All students, faculty, and administration are invited to attend meetings and all suggestions are welcome.

The success of Engineering School Activities depends entirely on you, the students. This is your school and only through enthusiastic participation by both graduates and undergraduates can SEAS realize its potential as a truly unique school. If your only real link with SEAS is a six digit number, then you are doing yourself and your fellow students a great disservice. Act now, you will not be disappointed.

Continued on Page 18

MAN ON THE MOON

Previous page left – On schedule to within less than a second, Apollo 11 blastoff from Launch Pad 35A at Cape Kennedy at 9:32 a.m. EDT. This was the start of the greatest single step in human history – a trip to the Moon, a manned landing and return to Earth.

Previous page upper right – Apollo 11 crew: (left to right) Commander Neil A. Armstrong, Command Module Pilot Michael Collins, and Lunar Module Pilot Edwin E. Aldrin, Jr.

Previous page lower right – Apollo 11 patch.

At left – The Earth as seen from Apollo 11 during its journey to the Moon.

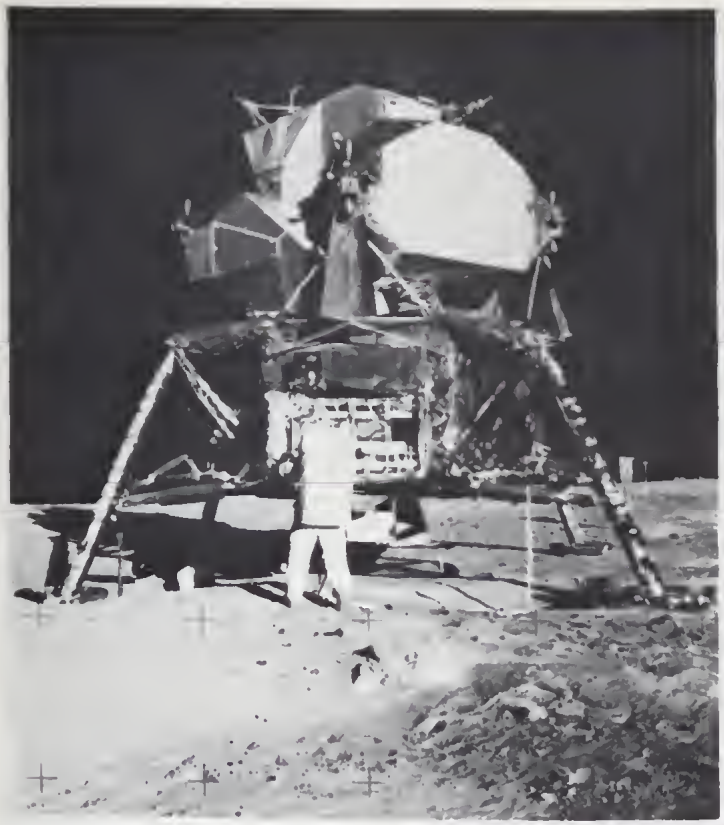
Lower left – Apollo 11 in orbit around the Moon. Oblique view of the lunar far side.

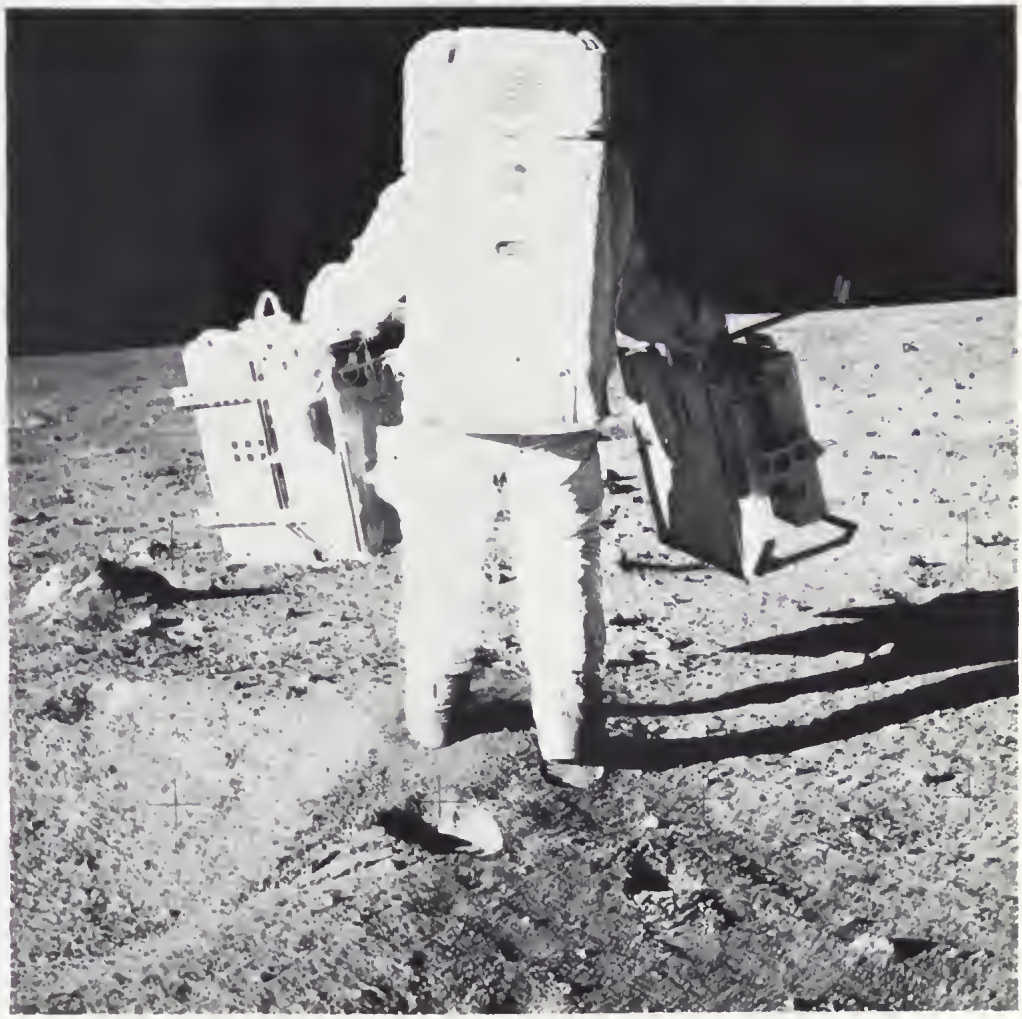
Below – The approach to Apollo landing site 2 seen from orbit. This view of southwestern Sea of Tranquility looks generally west.

Above — View of the Apollo Command Module with Astronaut Collins aboard as seen from the Lunar Module. Astronauts Armstrong and Aldrin in the LM have separated from Apollo 11 and prepare to go to the lunar surface. Moon terrain in the background is the far side of the Moon.

Right — Astronaut Edwin E. Aldrin, Jr. comes down the ladder of the Lunar Module, ready to join Astronaut Neil Armstrong on the Moon's surface.

All Photos courtesy of N.A.S.A.



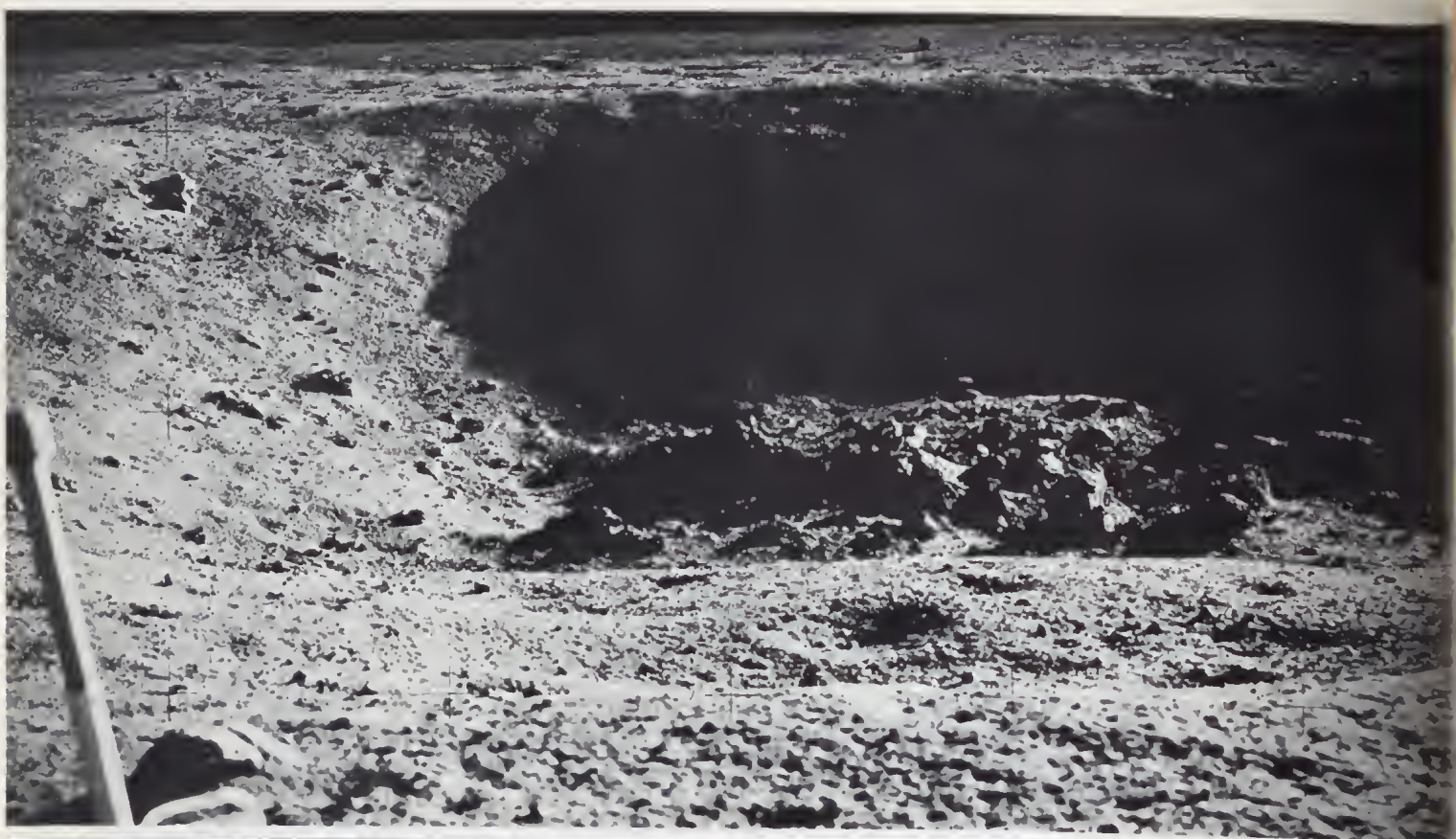


Left — Tranquility base, the U.S. flag and Astronaut Aldrin beside it.

Above left — Astronaut Aldrin prepares to deploy the Early Apollo Scientific Experiments Pack (EASEP) during the Apollo 11 lunar surface extravehicular activity.

Below right — Astronaut Aldrin carries the lunar seismometer and laser reflector experiments toward a level spot on the lunar surface.

Above right — Seismometer deployed, Aldrin walks toward the laser reflector and the LM.

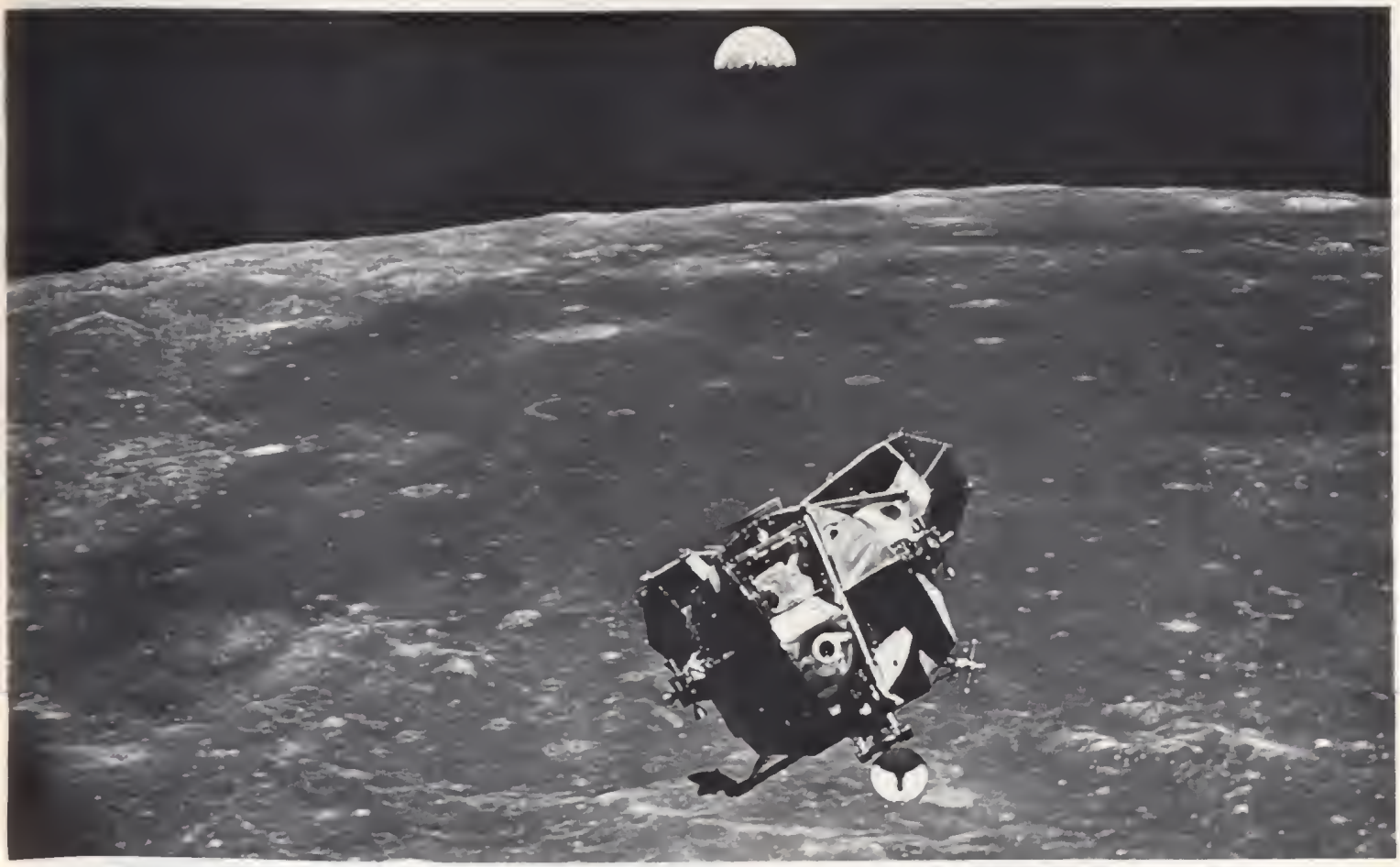


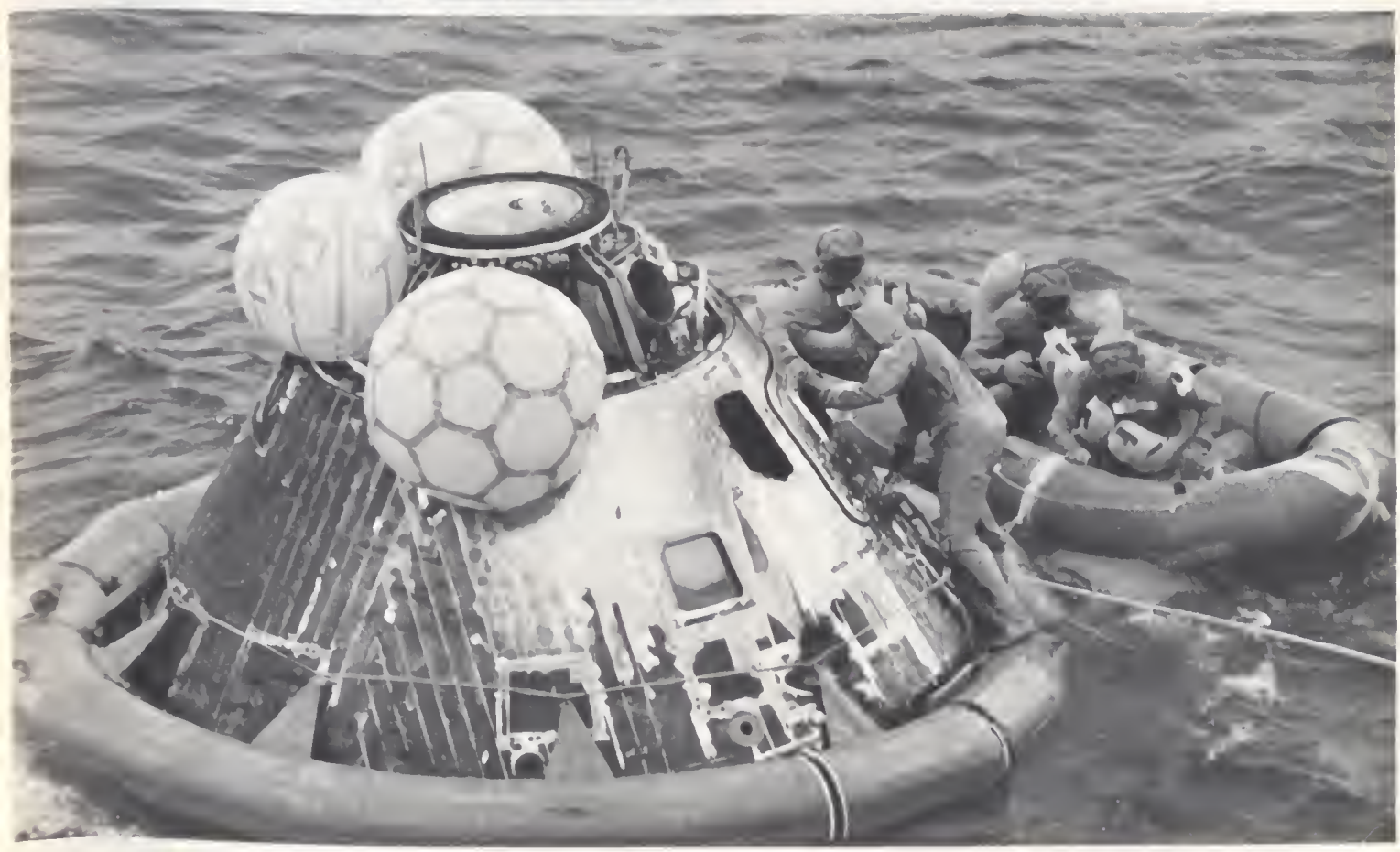
Above — A crater near the landing spot, on the Sea of Tranquility.

Left — The U.S. flag on the Moon and footprints of the men who put it there — the first men on the Moon.

Right above — The Lunar Module ascends from the Moon to rendezvous with the Command Module. Heading home to the planet Earth seen in the background.

Right below — Splashdown in the Pacific. Apollo 11 is a complete success.





I.E.E.E.

G.W.U.'s student branch of the Institute of Electrical and Electronic Engineers, I.E.E.E., is composed of Electrical Engineering majors who desire to be kept informed of current developments and controversies in their chosen field.

Last May the G.W.U. branch of I.E.E.E. elected new officers: Jerry Bonn, President; Steve Momii, Vice-President; and Jeff Jacox, Secretary.

Plans have been made for two Fall I.E.E.E. functions. The first will be a casual luncheon held on Wednesday, October 15, which will include an interesting movie and a minimal fee for a buffet lunch. This luncheon will provide a means for members to voice their desires for future I.E.E.E. activities. The second function will be a regular I.E.E.E. meeting held on November 12. The speaker will be announced in the near future.

The officers of I.E.E.E. hope members and all others interested will participate in this year's activities. Look for posters for further details.

SIGMA TAU

Sigma Tau is a national engineering honorary fraternity. Its purpose is not only to give recognition, but to combine the efforts of those student leaders of the S.E.A.S. that have proven themselves scholastically, practically and sociably, i.e. those qualities which are related to the promise of professional attainment.

Membership is open to students who have completed the first semester of their junior year and to Seniors. To be a candidate for membership, the student must have a Q.P.I. of at least 2.85. They must also receive the endorsement of at least three active members of the S.E.A.S. faculty, one of whom must be a member of Sigma Tau. Invitations for membership are extended once each semester. Elections and initiations are normally held twice a year.

At the George Washington University, the Xi Chapter of Sigma Tau has the following officers:

Faculty Advisor: Dr. George K. Lea
President: John Clay Davies III
Vice President: David R. Armstrong
Secretary: Michael Cook
Treasurer: Harrison Butturff
Historian & Pledgemaster: Dick Grissel
E.C. Representative: John Clay Davies III

TAU BETA PI

Tau Beta Pi is a national engineering honor society founded to honor the scholarship and exemplary character of undergraduates in engineering and alumni in the field of engineering. It has chapters in 120 colleges and universities, 31 alumni chapters, and over 130,000 initiated members.

Candidates are eligible from:

(1) undergraduate students in the upper 1/8 of the junior or upper 1/5 of the senior class and showing exemplary character.

(2) alumni of the college whose chapter may consider those who met the scholastic requirements as undergraduates.

(3) alumni of a college other than the one whose chapter may consider them, who met the scholastic requirements as undergraduates.

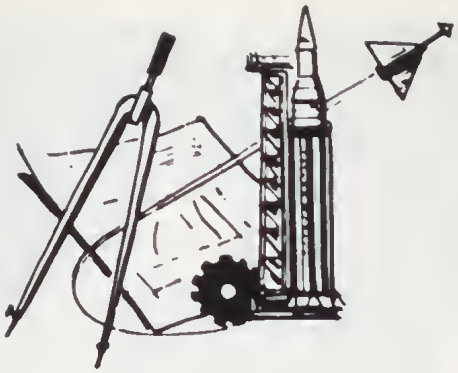
(4) engineers of high attainment in the profession, regardless of college attended, undergraduate scholastic record, or educational background.

Elections and initiations are normally held by the undergraduate chapter twice a year. Membership in Tau Beta Pi is limited to men although women are eligible under the same rules for award of the Women's Badge.

The George Washington University Chapter is the District of Columbia Gamma Chapter and Prof. Fox is the Faculty Advisor.

The officers of the Gamma Chapter are:

President: Robert Keltie
Vice President: Stuart Terl
Treasurer: Robert Keltie
Secretary: Rodolpho Laporta
E.C. Representative: Stuart Terl



Tech News

Edited by Gregory D. Smith, E.E., '72

Large ball lightning frightens peasants in this woodcut from an 1840 Frence science book. Ball lightning refers to floating, short-lived globes of light seen by many people but never recorded scientifically.

NEW IDEAS ON BALL LIGHTNING MYSTERY PROPOSED

WASHINGTON, Apr. 24 – Westinghouse scientists proposed here today new ideas about the strange, sometimes frightening balls of light that many people claim to have seen floating in the air.

Ball lightning typically drifts horizontally near the ground during a thunderstorm, has an orange glow about as bright as a 100 watt light bulb, and lasts about five seconds before disappearing suddenly, the scientists pointed out.

The flowing, grapefruit-sized globes were discussed in a technical paper presented at the meeting of the American Geophysical Union by scientists from the Westinghouse Research Laboratories.

Ball lightning has never been measured scientifically, and some skeptics put it in a class with flying saucers and ghosts.

"But an estimated five out of every hundred people have seen ball lightning," according to Dr. Martin A. Uman, the physicist who headed the project.

The new suggestion is that ball lightning may be a mixture of extremely hot air and soot or similar material caused by an ordinary lightning stroke hitting a tree or other object. This would explain some – but not all – of the features of ball lightning, the scientists said.

The color and brightness are much like those of a flame, whose light is due to glowing particles of finely divided carbon, or soot.

Dr. John J. Lowke, the physicist who presented the paper at the meeting, conducted a theoretical analysis to see if a ball of carbon and air with an initial temperature of 18,000 degrees Fahrenheit – roughly the final temperature of an ordinary lightning stroke – would behave like ball lightning.

"I found that when enough heavy soot particles are formed, the ball will not rise and heat generated by soot formation will slow down the rate of cooling. But it also turned out that the glow would be too dim to see," Dr. Lowke said.

The study showed that many kinds of finely divided particles could have the same effect as soot. But it ruled out plain balls of hot air, or hot air mixed with traces of metal vapor.

The scientists speculated that there may be several causes of ball lightning. Several years ago Dr. Uman investigated the possibility that it is caused by electric current flowing between clouds and ground, but this did not explain the many cases of ball lightning entering houses and other enclosures.

"Many ideas have been proposed about what ball lightning is, but few have been thought through to the extent of making detailed numerical calculations to find out if the ideas are sound," Dr. Uman said.

Here is a close-up of the silicon disc bearing messages from 74 heads of state which was left on the moon by the Apollo 11 astronauts. Using a Kodak photosensitive resist and Kodak high resolution plates, the Sprague Electric Company's Semi-Conductor Division prepared the historic disc for NASA.

KODAK PHOTOSENSITIVE RESIST USED TO ETCH MODN DISC

A coin-size silicon disc containing messages from 74 countries on earth lies on the surface of the moon. It rests within an 11-sided silver-anodized aluminum capsule left at Tranquility Base by the Apollo 11 astronauts.

The messages were etched on the disc by a process employing a Kodak photosensitive resist and Kodak high resolution plates, which have the greatest information storage capacity of any medium known to man.

The messages from foreign leaders congratulate the United States and its astronauts and express hope for peace to all nations of the world. Some are handwritten, others typed and many are in native language. A highly decorative message from the Vatican was signed by Pope Paul VI.

Each message was reduced 200 times to a size much smaller than the head of a pin and appears on the disc as a barely visible dot. Through a process used to make microminiature electronic circuits, the messages were etched into an ultra-thin quartz coating on the 99.9999 percent pure silicon disc. Silicon is a non-metallic chemical element found abundantly in nature and used widely in modern electronics.

The disc, being fragile, was transported by the astronauts in the aluminum capsule in which it now rests on the Sea of Tranquility.

The words on the disc, although not visible to the naked eye, can easily be read through a microscope.

The etching process began with the making of full-size photographic film positives of the original documents. These positives were then reduced in two steps to the final size. At this point, the messages, 1/200th of their original size, were recorded on a Kodak high resolution plate. The high resolution image was printed with ultraviolet light on a Kodak photosensitive resist coated on the silicon disc. Where light struck the emulsion, it hardened. The non-hardened emulsion was then washed away, leaving the message as a window in the photoresist material.

The disc was placed in a buffered solution of hydrofluoric acid and a surface coating of quartz etched away to expose the shiny grayish mirror-like surface of the silicon. The disc was then washed and the masking resist stripped off.

The Kodak high resolution plates used in the process have a resolving power that exceeds 2,000 lines per millimeter (50,000 lines per inch). This characteristic, coupled with extremely high contrast, extremely high acutance, and extremely fine granularity, makes these plates ideal for the most exacting applications of microphotography. Their information capacity would make it possible to store an entire 24-volume encyclopedia on a plate 6.35 x 6.35 cm (2½ x 2½ inches).

Silicon, which first came into general use during World War II in the production of diodes, was chosen to bear the miniaturized messages for its ability to withstand the extreme temperatures of the moon, which range from 120 degrees to minus 175 degrees Centigrade (250 degrees to minus 280 degrees Fahrenheit).

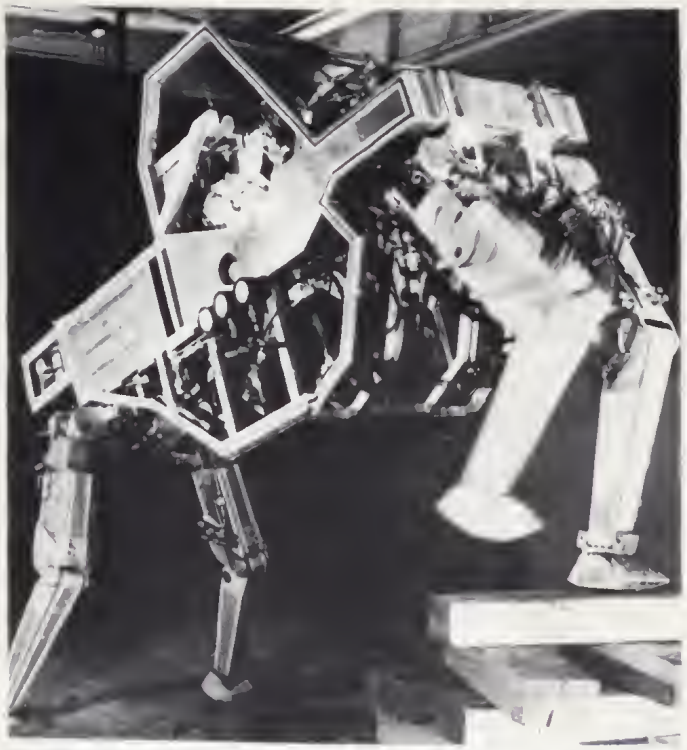
GE DEVELOPS NEW VEHICLE FOR THE MILITARY

The "force feedback" principle, developed in work on the four-legged "walking machine" by a General Electric Company consulting engineer has opened the way to a new family of materials handling devices.

A U.S. Army spokesman said that the "force feedback" principle could produce a variety of military applications for materials handling.

The "force feedback" system is an engineering technology in which part of the forces generated or encountered by the machine are duplicated and reflected to its operator. If the machine's foot, for example, strikes a solid object, the operator feels this contact with his arm or leg. Ralph Mosher, an international authority on Cybernetic Anthropomorphous Machine Systems (CAMS) technology, developed the "force feedback" control system for the walking quadruped.

He said that the operator of the 3000 pound "walking machine" can maneuver it forward or backward, balance it on two diagonal legs, make it climb over a four-foot-high obstacle or walk a narrow path.



"Forced feedback" is used in this four-legged walking machine, designed and developed by General Electric Company under U.S. Army contract. The research prototype — 11 feet high and 3,000 pounds in weight, was built by the GE Specialty Materials Handling Products Operation.

Ronald A. Liston, chief of the U.S. Army Tank-Automotive Command (TAXOM) Land Locomotion Division, said that the new system makes it possible for the walking robot to become an extension of the human operator's own arms and legs. In effect, it was stated, the operator actually feels what he is doing even in cases where he is unable to see.

In initial tests the four-legged "walking machine" has successfully walked across level ground, turned around, climbed obstacles, lifted a small military vehicle out of a mud hole and hoisted a 500-pound load onto a truck with one foot.

In the quadruped, a human being furnishes the nervous system for a four-legged machine constructed on the CAMS principle.

The robot is operated on a hydraulic system. As Mosher explained, the "muscle" on each leg of the prototype is a hydraulic actuator driven by high-pressure oil. Oil input to each actuator is regulated in direction, quantity and pressure by servovalves that respond to the operator's hand and foot controls.

The power system is made up of a gasoline engine, hydraulic pumps and hydraulic accessories, such as heat exchangers, and accumulator, filters and valves.

MEDICAL ENGINEERING

Edited by Jorge Aunon

This year's first issue of *Mechelecіv* introduces a section on Medical Engineering that will become a regular feature in future issues. In this first article, we will give a general picture of the activities in medical engineering, both in the academic and research areas of the George Washington University.

MEDICAL ENGINEERING AT G.W.U.

Medical Engineering is that field of applied science which attempts to apply engineering concepts to medical practice and research. The George Washington University has been at the forefront of Medical Engineering for a number of years. Monitoring of surgical and post-operative patients in the University Hospital has been done routinely for some time. More recently, the School of Engineering and Applied Science became actively engaged in the academic area by offering advanced degrees. In July of this year, the Medical Center established a new department, naming a physician internationally known as an authority in medical engineering as its head. Dr. Cesar A. Caceres, this summer, assumed the chairmanship of the Department of Clinical Engineering.

In the School of Engineering and Applied Science, Dr. Marvin F. Eisenberg has been the leading figure in stimulating the interest of students both as a teacher and able researcher. The physiological systems of the body may be taught in an introductory way by presenting overview pictures of interrelationships. Control and feedback mechanisms used by the body to regulate its functions then become clear, while at the same time, fundamental physiological concepts are learned. Dr. Marvin F. Eisenberg and Dr. Richard C. Fowler, Associate Professor of Medicine from the University Hospital, have formed a strong physician-engineer relationship that has been extremely successful in teaching introductory courses of medicine to engineers.

The Department of Clinical Engineering, while still in its planning stages, will encompass several general areas of education and development. Plans are currently being drawn for the establishment of courses primarily at the doctoral level. A faculty body is to be assembled shortly.

RESEARCH AT G.W.U.

In the area of research, a $2 million four-year contract for installing and operating a computerized system that gathers and disseminates continuous physiological data on critically ill patients was awarded to the George Washington University by the Public Health Service. The director of this project is Dr. Patricia Russell, Associate Professor of Anesthesiology, who for many years has been engaged in monitoring surgical and post-operative patients. When operational, the project will be an invaluable aid in training physicians and engineers in the continuous monitoring of essential physiological signals. Practical experience will become an adjunct to classroom lectures.

A multiphasic screening clinic for the hospital admission system and community health-risk detection center will be functioning in 1970. This clinic, under the direction of the Department of Clinical Engineering, will make full use of engineering principles as the key in the selection of a battery of physical and laboratory tests that can best screen populations, rapidly and economically, for health and disease.

The School of Engineering, in conjunction with the Rehabilitation Research and Training Center of the University, has begun a program to develop jobs for home-bound severely handicapped persons. Remote computer terminals are set up in a patient's home through which he is taught

the essentials of programming. This same terminal then enables this person to write and test computer programs without leaving his home.

In the area of sensory-evoked responses (brain responses evoked by a selected stimulus, such as flashing a light in the patient's eyes), two active laboratories have been set up. One is on the fourth floor of Tompkins Hall. This is for students research. The other is in the School of Engineering facilities at 2424 Pennsylvania Avenue, N.W. This is being used by Nick Sloan for research in fields of vision as part of a doctoral dissertation. Also in the past year, in conjunction with Dr. Patricia Russell, the undersigned completed a study on the effects of general anesthesia on sensory-evoked responses. This project served as a Master's Thesis and is expected to be expanded as a doctoral dissertation topic.

SUMMER INSTITUTE

Last summer, a Summer Institute for Biomedical Research in technology utilization was sponsored by the Goddard Space Flight Center, under the supervision of Mr. Kenneth Jacobs, the George Washington University, under the supervision of Drs. Eisenberg and Fowler, and NASA Headquarters. Results of this Institute have been the development of two "breadboard" devices. The first is a device that can remotely monitor a patient's physical activity and environment, such as heart rate, footsteps, noise level, etc., for a 24-hour period. The second is a compact system to attempt to "map" the blood flow through the human body using ultrasonic techniques. Participants in the project were undergraduate students from the George Washington University, University of Maryland, Auburn University, and Howard University.

The School of Engineering and Applied Science and the School of Medicine are planning joint efforts to develop new and more advanced courses in the area of Medical Engineering which may be applied as part of the requirements for a Doctoral Degree.

Future articles will feature more detailed explanations of the courses and the curriculum to be offered to students, the Multiphasic Screening Clinic, and the Automated Patient Monitoring Program.

Your comments, criticism, and questions are cordially invited and should be directed to the Editor of this section.

SUMMER INSTITUTE—CONTINUED FROM PAGE 9

students participated in the Summer Institute for Biomedical Research in Technology Utilization, a program sponsored by George Washington U. and NASA.

These students worked under the guidance of Dr. Marvin Eisenberg, EE professor at GW, Dr. Richard Fowler, M.D. from the George Washington Medical School, and Mr. Ken Jacobs, Technology Utilization Officer at Goddard. The ten students were split into five teams of two with each team getting a specific goal.

Ken Jacobs says, "The two projects were carefully selected to be both challenging and meaningful. Yet the project goals had to be realistic for a research effort of only ten weeks. Time was short, even for experienced engineers, and it is truly amazing that these undergraduate students have developed prototype hardware in this period."

Each of the five teams was assigned a technical adviser from Goddard. Three teams worked on a Physical Activity and Environment Meter (PAEM) while the other two teams had the task of the Ultra Sonic Motion Detection System (UMDS).

One team of the PAEM group was assigned the project of designing various input devices that would pick up signals of various parts of the body, mainly heart-beat, respiration rate, and footsteps per minute. The next PAEM team worked on a device to record these signals. The Unit had to be small enough to be worn by a patient without any resultant impairment to his normal activities. Low power had to be a criterion in the design since the PAEM had to run effectively for twenty-four hours on internal batteries. The third PAEM team designed and built the Readout System. The system will convert recorded pulses representing factors of a patient's physical condition onto a graphical display so that a doctor can interpret these results easily.

The first UMDS team researched and designed the transducers for the system so that they would operate in the 6MHz range of the UMDS unit. The second UMDS team designed the electronics for the unit. It had to be miniaturized to the size of a pack of cigarettes.

In addition to the research, the ten students took a course in Medical Engineering (EE181) at G.W.U. Dr. Fowler and Dr. Eisenberg taught the course with a special guest medical lecturer each week; each was a specialist in his own field.

Results of this summer's research will go to the George Washington University Medical School where the devices will be further refined.

G.W. students were Sonny Althouse, Dave Armstrong, John Davies, Mohammed Hatoum, Jake Azreal, Phil Ong, and Lenny Sirota. The three other students were Lou Biosca from Maryland, Jeff Green from Auburn, and Vic Johnson from Howard.

We developed TV transmission. But a lot of engineers still don't get the picture.

Like, we'll ask a graduating engineer: "What opportunities do you think an engineer has if he works for the telephone company?"

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